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ON THE TAXONOMIC STATUS OF *GILPINIA POLYTOMA* (HTG.) AND *G. HERCYNIAE* (HTG.) (HYMENOPTERA, DIPRIONIDAE) *

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The species known in America as the European spruce sawfly has been shown to be one of two species which have been confused under the name *Gilpinia polytoma* (Hartig) (1). One is arrhenotokous and is known only from Europe, and the other is thelytokous and occurs in Europe and America. This paper seeks to establish the correct nomenclature and provide adequate descriptions of the two species.

HISTORY

Hartig described a spruce sawfly, *Lophyrus polytomus,* in 1834 (6). Three years later (7) he described it in more detail and described also a new species, *L. hercyniae.* The descriptions were very similar, but Hartig stated that the two species were nevertheless distinct. In 1910, Rohwer (10) pointed out that *Lophyrus* Latr. was preoccupied by *Lophyrus* Poli and that the correct generic name for the species previously referred to *Lophyrus* Latr. was *Diprion* Schrank. Enslin, however, in 1914 and 1917 (3, 4) retained the name *Lophyrus.* Finally Benson (2), in his synopsis of the genera of the Diprionidae in 1939, erected the genus *Gilpinia* for the reception of *polytoma* and allied species.

Benson (2) divided *Gilpinia* into two groups; the "*polytoma* group", including species in which the inner hind tibial spur of the female is expanded into a leaf-like flap (no other known species in the family possess this character), and the "*socia* group", in which the inner hind tibial spur is normal. Since the arrhenotokous and thelytokous species bear the expanded inner hind tibial spur, they fall into the "*polytoma* group". The females of both species, therefore, are easily separated from another European spruce sawfly, *G. abieticola* (D. T.), which belongs to the "*socia* group". The males, however, are quite similar and are frequently confused, especially when all three species are taken from the same host tree in Europe. Benson (2) followed Enslin (4) in considering *hercyniae* a synonym of *polytomus.* Investigations in Canada and Europe show that two species were involved under a common name. Further study of Hartig's descriptions satisfied the writer that *polytoma* and *hercyniae* are valid names, representing respectively the arrhenotokous and thelytokous species as here recognized.

Many of the terms used by Hartig (7) do not have the meaning which we would attribute to them today. The terms which are most likely to cause confusion are listed below with their modern meaning: "Kopfschildchen" (cephalic shield, or area between antennal fossae and the clypeus) = face; "Oberlippe" (labrum) =clypeus (ante- and post clypeus combined); "Anhang" (appendiculum) = labrum; "Mittelbrustbein" = mesosternum (not mesothoracic leg); "Afterklappe" (anal flap) = ninth abdominal tergite; "Afterspitzchen" = cerci; "Randmahl" (carpus) = stigma; "Randader" (radius, marginal vein) = costa; outer surface (of femora) = dorsal surface. The modern interpretation is based on a glossary which appears at the end of Hartig's book and on a study of his figures and of the extensive introduction preceding his description.

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DESCRIPTION OF HARTIG'S SPECIES

Hartig's material was not available for comparison as it is probably in one of two places in Germany, either in the Forestry School at Eberwalde or in the Zoological Museum at Munich (8). These identifications are therefore based on his descriptions of both adult and larval stages. Hartig described from series, and if it becomes possible to examine his material, types will doubtless be selected. In the case of a thelytokous species like *hercyniae*, a female should be the type, particularly since there is some doubt whether Hartig's male and female belong to the same species.

Gilpinia polytoma (Hartig)

Lophyrus polytomus Hartig, 1834, Der Entomologische Teil in dem Forstliches und Forstnaturwissenschaftliches Conversatio·s Lexikon: 990-991, Nauch. Berlin.

Lophyrus polytomus Hartig, 1837, Die Familien der Blattwespen und Holzwespen, pp. 124-126, Berlin.

Lophyrus hercyniae Hartig, Enslin, 1914, Die Insekten Mitteleuropas inbesonder Deutschlands, pp. 178-180. Stuttgart (in part).

Lophyrus polytomus Hartig, Enslin, 1917, Deutsche Entomologische Zeitchrifte, Beiheft, 6:539-563 (in part).

Gilpinia polytoma (Hartig), Benson, 1939. Bull. Ent. Research 30:339-342 (in part).

The following is a translation of Hartig's original description (6).

"This heretofore undescribed species is the only one which I have found to date on spruce.

"Female: Dimensions:* 6. 2. 2¼. 3. 6. Antennae with 23 segments, otherwise not apt to be confused with *Lophyrus rufus*. Head yellow. A broad black band between the eyes near the lower margin of which the black antennae with two yellow basal joints are placed in the yellow field. Thorax with both lateral areas black. Scutellum yellow. Cephalic area (middle lobe) yellow with black spot. Sides yellow. Sternum more or less black. Abdomen with yellow base. All other segments yellow completely ringed with black. 'Afterklappen' (ninth tergite) yellow. Outer side of all femora black. Claws black. Tarsal joints ringed with black. Tibiae of hind legs with black tip. Stigma yellow.

"Male: Dimensions: 4½. 2. 2. 2. 5. Antennae with 22 pectinae and one apical joint, longer than the thorax. Black. Region of the mouth, lateral lobes as well as legs yellow. Abdomen entirely red ventrally; dorsally only the last segment red. Stigma red. Larva white to greenish, on spruce needles.

The larva is one of the most beautiful *Lophyrus* larvae. It exhibits at first sight considerable resemblance to the caterpillar of *Noctua piniperda*. Head brown, lighter near the mouth parts, yellowish white. Between and above the eyes, but not touching them, there is a dark, pentagonal spot which is continued in a narrow strip on the cranium. In the middle of the pentagon there is a bright triangle. On each side of the cranium there is a dark arched marking. Body up to ¾ inch long. Dorsum, as far as pleural suture, beautiful apple green with milk-white dorsal and lateral stripes. Venter and feet dark flesh-red. The larva is not gregarious and eats, as all other *Lophyrus* larvae, only the old needles. Pupation during the first days of June. Cocoon on the spruce needles, white to greenish. Emergence after 14 days pupation. As *Lophyrus pini*, and under the same conditions, probably overwinters in the egg stage."

A translation of the essential additional characters given in Hartig's later description (7) follows.

"Female . . . . Length 3 lines, wing spread 7¼ lines. Body form similar to that of the female *L. pini* but on a smaller scale. There is also considerable correspondence in colouration, especially with respect to the ground color,

*Hartig explains elsewhere that these dimensions are to be interpreted as body length, head width, thorax width, abdomen width, and anterior wing length, respectively.

which is also in this case dirty pale yellow. . . . . They (the antennae) are almost as long as the thorax. The hind part of the head, next to the thorax, is black. The mouth-parts are yellow, only the mandibles have a brown tip. On the dorsal side of the thorax the collar is yellow; the lateral lobes, as far as their depression towards the base of the wings, are black, the medium lobe bears a large black spot. . . . . The ventral segments (of the abdomen) also have a distinct edging anteriorly although it is paler and narrower (than on the dorsum) . . . . Legs pale yellow with exterior of the base of hind tibiae and outer surface (that is to say, the side next to the body) of all femora shiny black. . . . .

"Male. . . . . Antennae with 22 pectinae. Length, 2¼ lines, wing expanse 6 lines. Head black with face, clypeus, and palpi bright yellow. The abdomen is black dorsally as far as the last segment; this and the entire ventral surface are cinnabar red. Legs yellow, only the base of the middle and hind coxae on the outer side and the claws are black.

"The larva . . . . attains a length of at most ½ inch and a width of ½ to ¾ line. . . . . The dorsal surface of the body is apple-green with a darker seam on both sides at the height of the spiracles. The green back is divided into four approximately equal parts by a single dorsal and two lateral milk-white stripes. The venter, the abdominal legs, and the sides as high as the green seam are dark flesh red colour. The abdominal legs bear black plates. . . . . ..

"This is the only *Lophyrus* larva which I have thus far found feeding on Norway spruce, particularly in the Berlin Zoological Garden. . . . Undoubtedly there is also a fall generation whose larvae hibernate in the cocoon* and become adults towards the end of April."

Reasons For Assigning the Name *polytoma* to the Arrhenotokous Species

Many of Hartig's characters described above apply to both the arrhenotokous and thelytokous species, but the arrhenotokous species is considered to be *G. polytoma* chiefly on the grounds of size and colour of the female adult, colour of the legs of the male adult, and colour of the larva.

Hartig's measurements of the female show that his *polytomus* was the smaller of the two species, this agreeing with our observations. His reference to the fact that the female of both *L. polytomus* Htg. and *L. pini* L. are similar in ground colour, both being pale yellow, is particularly important, because in the arrhenotokous and thelytokous species, the former shows more yellow and is closer in color to *pini* than is the latter. The statement that the mouthparts of the female *polytomus* are yellow except for the tips of the mandibles applies to most individuals of the arrhenotokous species but never, to the writer's knowledge, to the thelytokous species, which has a brown labrum. Hartig described the femora of the female as having black on the outer (yellow on the inner) side. This character, while not specific, applies more often to the arrhenotokous than to the thelytokous species. His reference to black on the legs of the male being confined to the middle and hind coxae and tarsal claws is in agreement with most specimens of the arrhenotokous species and does not conform with the thelytokous species, which has black on the dorsal side of the hind femora. Finally, Hartig's description (7) of the larva as possessing a red venter and three white stripes prevents any association of his material with the thelytokous species, as the latter has a green venter and five white stripes. Smith (11) has shown that the larvae of the arrhenotokous species have two colour phases, one with a red, the other with a green venter and indistinguishable from the thelytokous larva. It is clear, therefore, that Hartig was dealing with the red colour phase of the arrhenotokous species.

*This corrects the statement in the original description to the effect that this species "probably overwinters in the egg stage".

There are two instances of lack of conformity between Hartig's *polytomus* and the arrhenotokous species. Hartig gives the number of antennal segments as 23, while in the arrhenotokous specimens examined it ranges from 17-21. Hartig gives the colour of the scutellum of *polytomus* as yellow, while in the arrhenotokous species it is yellow margined with black caudally. This lack of conformity with Hartig's description, however, is very slight, and in general the original description of *polytoma* is in closer agreement with the arrhenotokous than the thelytokous species.

Redescription of *polytoma* Htg.

Only a small number of pinned specimens were available to the writer. Some of the specimens originated from stock collected in Czechoslovakia and were reared from families whose chromosome number and type of reproduction were known. Others were reared from field collections made in Czechoslovakia. The best of the pinned material has been deposited in the Canadian National Collection at Ottawa. Large numbers of specimens from Czechoslovakia, Finland, and Sweden, preserved in alcohol, were also examined for structural characters, such as those of the antennae and genitalia. Living larvae were not available, but preserved material from Europe, presumably containing both *polytoma* and *hercyniae,* was examined.

Female. Length 6.6-8.1 mm., average 7.2 mm. Head mostly yellow; a brown band between compound eyes enclosing ocelli and extending to antennal foveae; caudal surface of head black. Antennae serrate below; antennal segments 17-21, average 20; scape and pedicel yellow; flagellum black. Mandibles reddish distally, brown proximally; other mouthparts mostly yellow, though labrum in some specimens tends towards brown as in *hercyniae.* Thoracic dorsum mostly black with following parts yellow; angles of pronotum, caudo-lateral margins of praescutum, large spot on each side of scutum near parascutellar area, and all of scutellum excepting caudal border. Thoracic sternum yellow and brown, lighter than in *hercyniae.* Mesepisternum brown with latero-ventral spot and sometimes latero-mesal spot of yellow on each side. First abdominal tergum mostly yellow, black proximally and on both sides Abdominal terga 2-8 with yellow band proximally, black band distally, black on both sides; tergum 9 black dorsally and yellow on sides; tergum 10 brown to black. Abdominal sterna with yellow proximal and brown distal bands, yellow usually predominating. Legs yellow and black; distal end of hind tibia black; inner spur of hind tibia expanded into leaf-like flap. Femora black on the dorsal side, hind femora sometimes black on both sides.* Tarsal joints black distally. Wings slightly cloudy, venation brown to black, stigma yellowish-brown. Lancet usually with 9 or 10 rows of teeth (Fig. 5).** Process on each side of proximal end of saw slender and pointed (Fig. 2, 30-34); short carina sometimes present near outer edge of process but never extending completely across, more frequently missing entirely.

Male. Length 6.0-7.2 mm., average 6.6 mm. Colour mostly black. Head black with labrum and clypeus yellow. Antennae black; flagellum with 19-23 biramose segments, usually followed with a segment bearing a single ramus and a simple distal segment. Thorax black except for yellow angles of the pronotum. Thoracic dorsum, particularly scutellum, finely punctate. Abdomen black dorsally, yellow to ferruginous ventrally. Legs mostly yellow; coxae

*Of 10 pinned specimens of 6-chromosome, arrhenotokous families, all have black on the dorsal side and 7 have a varying amount of black on the ventral side, though less than in *hercyniae*. In another series of preserved specimens, 45 of 49 have black on the dorsal side only, and 4 have black on both sides.

**The number does not exceed 10 in any of 25 adults of known chromosome number, but there is one exceptional case among 348 adults reared from field-collected cocoons in which the lancet bears 11 rows of teeth.

black proximally; dorsal side of femora and distal end of tibiae sometimes brownish. Tarsal claws with a subapical tooth. Wings smoky, stigma reddish. Sagittae (Fig. 9, 23-25) spatulate, distal third membranous.

Larva. The larva has two color "phases," both of which have been reared from the same parent by Smith (11). The red phase, or mutant, as described by Smith, has in the fourth and fifth instars "a salmon red ventro-lateral stripe running the whole length of the body, a salmon-red underside to the abdomen, and only faint markings over the base of the prolegs".* The green phase has five white body stripes and a green venter and apparently cannot be distinguished from the larva of *hercyniae*.

Mr. W. F. Sellers, of the United States Bureau of Entomology and Plant Quarantine, mentions in correspondence his discovery in Europe of a larva in which the ground colour, both dorsally and ventrally, was completely red. The identity of this all-red larva has not been established, and it remains an open question as to whether it may be a phase of *polytoma* or some other species.

Discussion of Principal Characters. The principal characters that separate *G. polytoma* Htg. from allied species are structural, but color is useful, though not always reliable. The female is distinguishable from that of *abieticola* by the "flap" on the inner hind tibial spur, which is not present in the latter species. *G. polytoma* is almost invariably separable from *hercyniae* in having not over 10 rows of teeth on the lancet (one exception in 348 observations), the latter possessing 11 or 12. The more weakly developed and pointed process attached to the proximal end of the saw will generally separate *polytoma* from *hercyniae,* and the absence or incomplete development of a carina on the process usually distinguishes this species from *hercyniae,* in which the carina almost invariably extends from one side of the process to the other. The female can usually be separated from that of *hercyniae* by its lighter colour, particularly of the venter, labrum, and ventral surfaces of the femora, though the colour of the two species tends to intergrade. The male is distinguishable from *hercyniae* and *abieticola* by finer punctation on the thorax, more spatulate and less sclerotized sagittae, and paler metathoracic femora.

Method of Reproduction. Arrhenotokous parthenogenesis. Proportion of males to females in material examined 458:344.

Cytology. Chromosome number of males 6, of females 12 (Smith (11)).

Host. Reported from *Picea excelsa* Link.

Distribution. First described from Germany by Hartig (6) and later by Ratzeburg (9). Since Hartig (7) mentions finding larvae in the Berlin Zoological Garden, it would be desirable to have the type selected from specimens collected in this district. Berlin could then be designated as type locality. Other larvae, described as possessing a red venter and presumably incorrectly identified as *hercyniae,* were also reported from Germany by Escherich and Baer (2). The writer has examined material from Czechoslovakia, Sweden, and Finland, but this species probably has a wider European distribution.

Gilpinia hercyniae (Hartig)

Loyphyrus hercyniae Hartig, 1837. Die Familien der Blattwespen und Holzwespen, pp. 123-124. Berlin.

Lopyhrus hercyniae Hartig, Enslin, 1914. Die Insekten Mittleuropas inbesonder Deutschlands, pp. 178-180. Stuttgart (in part).

Lophyrus polytomus Hartig, Enslin, 1917. Deutsche Entomologische Zeitschrift, Beiheft, 6:539-563 (in part).

Gilpinia polytoma (Hartig), Benson, 1939. Bull. Ent. Research 30:339-342 (in part).

A translation of Hartig's original description (7) follows.

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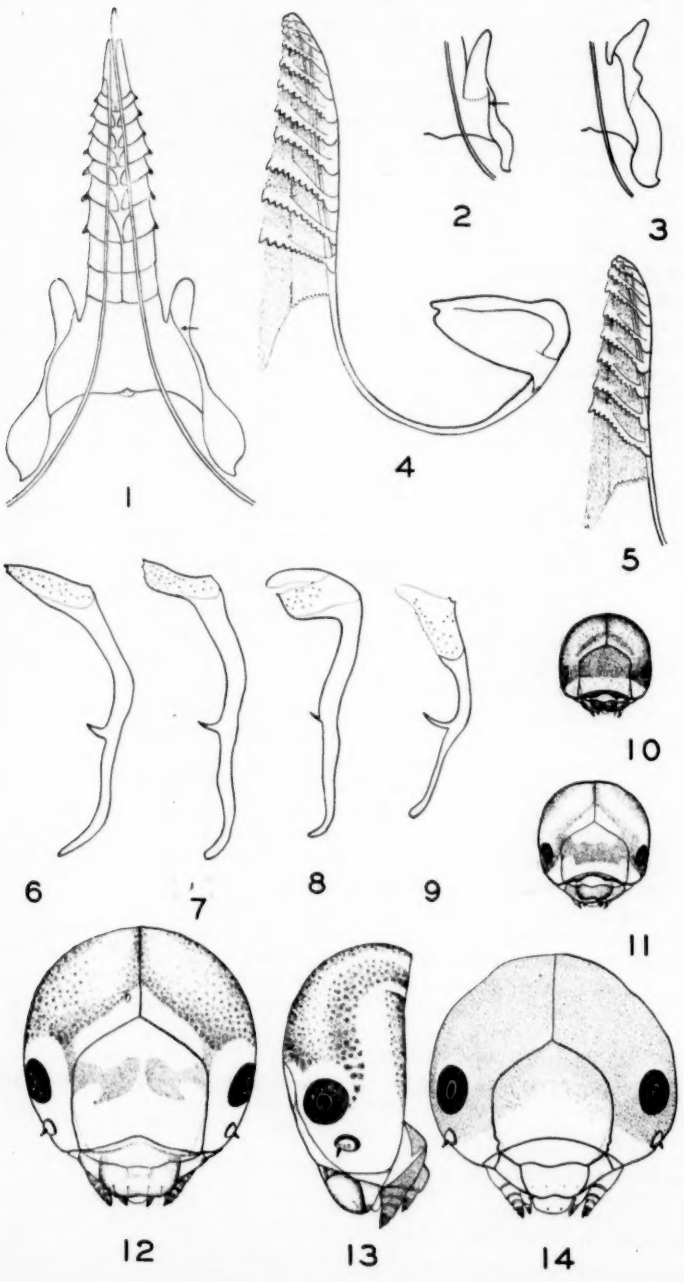
*It appears that the red phase has only three white body stripes, though the writer has been unable to verify this point.

PLATE XI.



SPECIES OF *GILPINIA*

"Female. Pale brownish yellow. Frontal band extending below the antennae. Labrum, base of clypeus, antennae, 3 dorsal spots on thorax, underside of thorax, femora as far as the joint, tip of tibiae and tarsal joints, black. Abdominal segments broadly edged with black, Antennae with 21 joints.

"Ground colour pale brownish yellow. A broad transverse band between the eyes covers the greater part of the head, its upper margin covers the ocelli, it extends along the sides of the antennae as far as the mouth, leaving free only a quadrangular spot between and below the antennae.. The clypeus is separated from the face by a narrow black stripe, the labrum and back of the head black, but the cheeks and hind margins of the eyes are pale yellow. Only the 2 basal joints of the black, 21-jointed antennae are pale yellow. On the dorsum of the thorax there is a half oval spot on the anterior margin of the middle lobe. The two lateral lobes (as far as a longitudinal spot on the sides), a narrow margin of the scutellum, and the entire metathorax are black. The anterior margin (*sic*) and the mesosternum are shiny black; the latter has pale yellow lateral spot. The dorsum of the abdomen is blackish brown, the first segment is entirely pale yellowish brown in the centre, whilst the other segments are so only on the sides near the base. These latter segments also have the basal part of the dorsum pale yellow. The ventral segments are broadly edged with black. The 9th abdominal tergite is black at the base and has a black dot situated closely below the cerci. The legs are pale yellow, the tibiae almost whitish, the coxae, especially the posterior ones, are black at the base, the trochanters have a blackish joint. The anterior femora are black at the base and also on the back as far as the joint. The hind femora are completely black as far as the joint.. The tips of all tibiai and tarsal segments are black. Wings darkened at the apex. Veins black, stigma reddish yellow surrounded with black, marginal vein rusty red toward the base. Squamulae yellow.

"Male. Black, collar yellow, venter red with blackish brown transverse markings. Legs rusty yellow. Inner sides of the coxae, trochanters, and femora black. Antennae with 21 pectinae.

"Size and body form of both sexes entirely as in *L. virens*. (Length of *L. virens* 4 lines, wing expanse 9-¾ lines.)

"Quite as long as *L. virens*, but slimmer and with longer antennae. Differentiated from the above and from other allied species by the fact that the mouth is uniformly black as far as the yellow palpi. The antennae are nearly as long as the head and thorax; they have 21 pectinae and two apical joints. On the thorax, the collar is broadly edged with yellow, otherwise the entire upper side (dorsum) as far as the red genitalia is uniformly black. The venter is rusty red. The edges of the segments and also those of the turned down part of the dorsal segments are dark rusty brown; they are lighter and narrower towards the rear and almost fade out. Legs similar in color to venter, but somewhat lighter rusty red. Base of coxae black. Trochanters and half of femora on the side nearest the abdomen black. Wings as in the female.

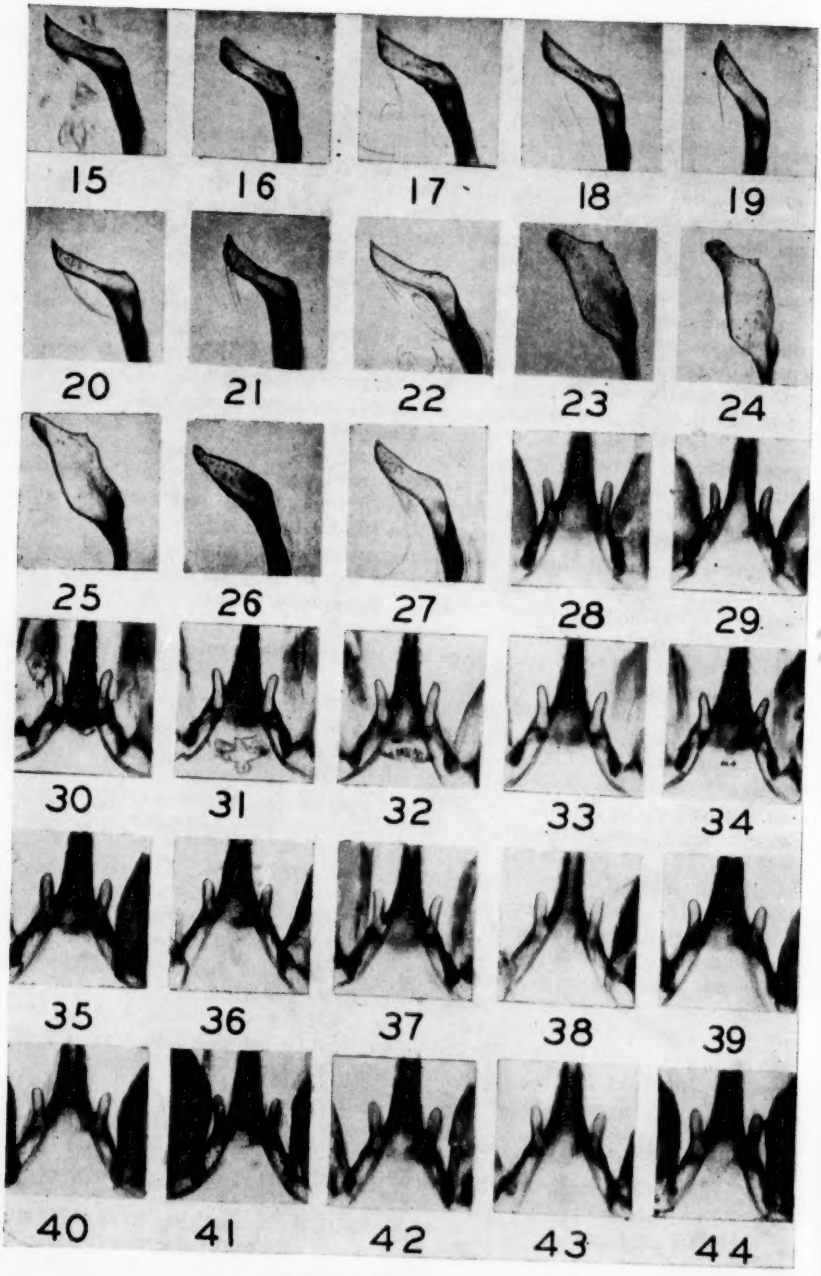
"One male and several females were captured by Herr Saxesen in the Harz Mountains, and there is little doubt that this species which is closely allied to, yet quite distinct from *L. polytomus*, also blongs on Norway spruce."

Reasons for Assigning the Name *hercyniae* to the Thelytokous Species

Reasons for identifying the thelytokous species with *G. hercyniae* are similar to those given for the other species, namely, agreement in size, ground colour, colour of labrum and hind femur of the female, and colour of the femora of the male.

Hartig's comparison of *L. hercyniae* with *L. virens* Klug in size (length 4 lines, wing expanse 9½ lines) and colour shows clearly that he was dealing with a larger and darker species than *polytomus* (length 3 lines, with expanse 7¼ lines). These characters, ground colour, and length generally distinguish the

PLATE XII.



SPECIES OF *GILPINIA*

thelytokous from the arrhenotokous species, though there is some intergrading. Hartig's reference to the labrum of the female being black applies without exception to the thelytokous female. Likewise, his statement that the hind femur is completely black as far as the joint applies to all Canadian and most European specimens of the thelytokous species and less frequently agrees with the arrhenotokous species. The femora of the male are described by Hartig as having black on the outer (dorsal) side. This is true of the hind femora and to a less extent of the middle and front femora of the thelytokous species. Since Ratzeburg (9) specifically mentions black on the hind femora of *hercyniae*, his description applies more closely to the thelytokous male than Hartig's. The significant point, however, is that in so far as the colour of the femora of the male is concerned, Hartig's description is closer to the thelytokous species than to *polytoma*, in which all femora are usually yellow.

There are two points in respect to the male that create some doubt as to whether Hartig's male and female specimens of *hercyniae* were conspecific. The first relates to the chance finding of a male with "several" females. Considering that our records show the sex ratio to be approximately 1 male to every 1200 females in Canada, one would expect the odds against Hartig securing a male to be very high, although such is not impossible. The second point is based on the interpretation of the word "Mund" (mouth). He indicates that the mouth is uniformly black as far as the yellow palpus, differentiating *hercyniae* from *virens* and other allied species. If this term can be interpreted as including the clypeus and mouthparts, then it is quite possible that Hartig's male belonged to a species different from his female, since these structures in the thelytokous male are not uniformly black but vary from luteous to whitish. On the other hand, the clypeus and mouthparts of the latter species are usually slightly darker than in the arrhenotokous species and it may be to this relative difference that Hartig referred when he described the mouth as black. Because of the uncertainty of the correctness of the association of the two sexes in Hartig's material the female characters should be made the basis for the recognition of the name *hercyniae*.

Redescription of *hercyniae* Htg.

Most of the material examined in preparing the following description was collected in the Gaspé peninsula, Quebec, and in New Brunswick. This is deposited in the Canadian National Collection at Ottawa. A few specimens from Canada and Czechoslovakia, reared from families of known chromosome number and type of reproduction, were used in the study of the genitalia. Specimens reared from cocoons collected in Czechoslovakia, Finland, and Sweden, were also used for the latter purpose (1).

Female. Length 6-9.5 mm., average of 40 specimens 8.5 mm., generally longer than *polytoma*, which averages 7.2 mm. Colour of head similar to that of *polytoma*, but band between eyes more black than brown and wider. Labrum brownish, darker than in most *polytoma*. Antennae serrate below, mostly black, two proximal segments yellow. Antennal segments 20-22 (frequency distribution of 68 specimens being 8-20, 48-21, and 12-22.) Thoracic dorsum black with yellow markings as in *polytoma*;* thoracic venter black and yellow, darker than in most *polytoma*. Mesepisternum black with latero-ventral, and occasionally latero-mesal, spot of yellow on each side. Abdomen similar to that of *polytoma*, but dark bands on venter more black than brown, and venter in general darker. Coxae black at proximal ends, trochanters black. Tibiae yellow,

*The scutella of 9 of 92 alcohol specimens from Scandinavia show a colour variation in which the yellow field tends to be divided by a broken line of black along the meson.

black distally. Inner hind tibial spur expanded into leaf-like flap. Front and middle femora black on dorsal side, mostly yellow on ventral side; hind femora generally black on both sides. (Hind femora of all Canadian specimens black on both sides, but this character falls down in two of 10 European specimens from 14-chromosome females and in 4 of 57 alcoholic specimens from Europe. In these exceptional cases, only the dorsal side is black). Tarsal segments yellow and black. Tarsal claws with subapical tooth. Wings slightly cloudy, veins brown to black, stigma reddish yellow surrounded with black, costa red towards base. Tegulae yellow. Lancet with 11 to 12 rows of teeth (Fig. 4), and distal third relatively narrower than in *polytoma*. Process at proximal end of saw larger and more broadly rounded distally (Fig. 1, 35-44) than in *polytoma* (slightly modified in shape (Fig. 3) in 8 European specimens examined). Carina (Fig. 1, arrow) usually extending obliquely across process (1 exception in approximately 100 Canadian specimens examined) and distinguishable from *polytoma* (Fig. 2) in which the carina is missing, or at most present only near the outer side.

Male. Length 4.0-8.5 mm., average of 15 specimens 6.8 mm. Colour mostly black. Labrum and clypeus generally brownish or luteous, sometimes whitish, but usually darker than in *polytoma* and *abieticola*. Mandibles red distally, black proximally. Antennae of 15 specimens with an average of 27 segments ranging from 24-28. Flagellum with 20-25, average 23, biramose segments, usually followed by a penultimate segment with a single ramus and a simple distal segment. Thorax black except for yellow angles of pronotum. Dorsum of thorax, particularly the scutellum, coarsely punctate as in *abieticola*. Dorsum of abdomen black, venter yellowish to ferruginous, darker on sides. Hypandrium ferruginous. Legs mostly yellowish, with proximal ends of coxae, dorsal side of hind femora, and sometimes middle and front femora, blackish. Tibiae sometimes brownish distally. Tarsal claws with subapical tooth. Wings as in female. Sagittae (Figs. 7, 15-22) pedate; distal third more sclerotized and with coarser armature than in *polytoma* (Figs. 9, 23-25); apex usually with 2-5 spines and more obtuse than in *abieticola* (Figs. 6, 26-27).

Larva. Measurements: (number measured, range, and average width of head capsule in mm.). Stage 1, 32, 0.61-0.65, 0.62. Stage 2, 38, 0.75-0.94, 0.84. Stage 3, 92, 1.08-1.27, 1.17. Stage 4, 200, 1.45-1.69, 1.55. Stage 5, 715, 1.74-2.02, 1.87. Stage 6, 20, 1.81-1.99, 1.88.

The larval head is mostly black in the first instar (Fig. 10), becoming more brown in second (Fig. 11) and succeeding instars, and greenish brown in the sixth (Fig. 14). First four instars not definitely distinguishable by body colour, which is mostly green, but the fourth instar begins to show white stripes. These become very distinct in the fifth instar but disappear on rubbing or immersion in alcohol and are absent in sixth.

Fifth instar (last feeding stage) with markings on head capsule as shown in figures 12 and 13; labrum light brown margined with black, mandibles reddish, sclerotized portions of maxillae and labium brown to black. Antennal and ocular sclerites black. Two basal segments of antennae light brown, distal segments black. Body green with five white stripes, a dorso-mesal, two dorso-lateral, and two lateral; also a blackish dorso-lateral and a broken pedal stripe on each side. For a short time following the fourth moult, dorso-mesal white stripe absent, but always present in the mature fifth instar. Spiracles light brown. Thoracic leg segments dark brown to black, uropods pale green. The larva apparently indistinguishable from the green phase of *G. polytoma*.

Discussion of Principal Characters. The principal characters distinguishing *hercyniae* from *polytoma* have already been discussed. The female *hercyniae* is easily separated from the female *abieticola* by the leaf-like inner hind tibial spur, but the males of these two species are very similar. Enslin (4) used the

number of "bipectinae" as a key character for males, giving the number as "mostly 19" for *abieticola* and 21-23 for *polytomus* (in which he included *hercyniae*). The writer has examined one specimen of *abieticola* reared from the larval stage. It possessed 22 biramose segments. Of five other specimens reared from cocoons from the same locality (Czechoslovakia), four had 20 and one had 21 biramose segments. It is evident, therefore, that there is an overlapping in the two species so far as the number of pectinae is concerned. The males of both species are coarsely punctate on the thorax, and there is much similarity in the degree of black on the dorsal surface of the femora, though there may be some exceptions since according to Enslin the "inner"* sides of the thighs are sometimes brown. The labrum and clypeus of the male *hercyniae* are generally darker, but the most reliable character is the shape of the distal third of the sagittae. The distal ends of the sagittae are relatively wider, more obtuse, and usually bear more spines, the number generally ranging from 2 to 5. In *abieticola* the number of spines is also variable, usually being 1 or 2.

Method of Reproduction. Thelytokous parthenogenesis. Males rare in Canada, 1 to 1200 females (1).

Cytology. Chromosome number of males 7, of females 14 (Smith (11)).

Hosts. Most common hosts in America are *Picea glauca* (Moench) Voss, *P. mariana* (Miller) Britton, and *P. rubra* Link. Other species, such as *P. abies* (L.) Karst, *P. pungens* Engelmann, *P. sitchensis* (Bongard) Carriere and *P. excelsa* Link also attacked.

Distribution. The known distribution at the time of Hartig's (7) original description was only the Harz Mountains in Germany. The European distribution, based on material examined by the writer, also includes Czechoslovakia, Finland, and Sweden.

The distribution in Canada includes the provinces of Ontario, Quebec, New Brunswick, Nova Scotia, and Prince Edward Island; in the United States it occurs in Maine, New Hampshire, Vermont, Massachusetts, Connecticut and New York.

KEY TO ADULTS

Females

1. Inner hind tibial spur expanded into a leaf-like flap 2
   Inner hind tibial spur not expanded into a leaf-like flap ... *G. abieticola* (D.T.)
2. Lancet with 9-10 rows of teeth. Process at proximal end of saw weakly developed, distal end pointed. Process without carina, or at most carina present only near outer edge. Labrum and venter usually more yellow than brown. Hind femora usually black only on dorsal surface. ..... *G. polytoma* (Htg.)
   Lancet almost invariably with 11-12 rows of teeth. Process at proximal end of saw broadly rounded at apex. Carina on process almost invariably extending from one side to the other. Labrum brown. Venter of thorax usually more black than yellow. Hind femora usually with black on both ventral and dorsal surfaces ..... *G. hercyniae* (Htg.)

Males

1. Punctation on dorsum fine. Sagittae spatulate, distal third membranous. Hind femora mostly yellow ..... *G. polytoma* (Htg.)
   Punctation on dorsum coarse. Sagittae pedate, distal third strongly sclerotized. Hind femora mostly black on dorsal surface 2
2. Distal end of sagittae truncate (Fig. 7) ..... *G. hercyniae* (Htg.)
   Distal end of sagittae acute (Fig. 6) ..... *G. abieticola* (D.T.)

*"Inner" probably should be interpreted as dorsal.

NOTE ON A RELATED SPECIES

A mixed lot of adults, reared from larvae collected from spruce in Finland, contained two unusual males. These possess 17 and 18 biramose antennal segments, respectively, and an entirely different type of sagitta, which is bifurcate distally (Fig. 8).

ACKNOWLEDGEMENTS

Several officers of the Division of Entomology, Ottawa, have assisted in this work. Helpful suggestions and criticisms were provided by Messrs. R. E. Balch, G. S. Walley, and Dr. O. Peck. Dr. S. G. Smith, of McGill University, made the photographs of the genitalia.

EXPLANATION OF PLATES XI. AND XII.

1. Saw of *G. hercyniae* (posterior view). Arrow indicates position of carina.
2-3. Process at base of saw (posterior view). 2, *G. polytoma;* 3, Variation of European *G. hercyniae*. Arrow indicates position of carina.
4-5. Lancet (lateral view). 4, *G. hercyniae;* 5. *G. polytoma.*
6-9. Left sagitta of aedeagus (lateral view). 6, *G. abieticola;* 7, *G. hercyniae;* 8, *Gilpinia* (?) sp. from Finland; 9, *G. polytoma.*
10-14. Head of *G. hercyniae* larva. 10, first instar; 11, second instar; 12 and 13, fifth instar; 14, sixth instar.
15-27. Distal end of sagitta (lateral view). 15-21, *G. hercyniae* (Canadian); 22, *G. hercyniae* (European); 23-25, *G. polytoma;* 26-27, *G. abieticola.*
28-44. Proximal end of saw showing process (posterior view). 28-29, *G. abieticola;* 30-34, *G. polytoma;* 35-39, *G. hercyniae* (European); 40-44, *G. hercyniae* (Canadian).

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EUPITHECIA NOTES, II*

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As a result of further studies of *Eupithecia* species chiefly in connection with their genitalia, the following notes have accumulated. As they may be of some certain interest to other workers in the group, I am publishing them at the present time.

Eupithecia gibsonata Tayl. By an error *gibsonata* was placed in the Check List as a synonym of *chagnoni* Swett. As a matter of fact, Taylor's name has a year's priority and will be available as the specific name of the species with *chagnoni* Swett as the synonym.

Eupithecia herefordaria C. & S. This appears to be merely a southwestern race of the eastern *exudata* Pears. Slides of the male genitalia, which have been compared with the type slides of both species, agree with each other. The name *exudata* Pears. has priority, but its present position as given in the Check List is not entirely satisfactory and it might be advisable to transfer it to the listed position of *herefordaria* C. & S.

Eupithecia multistrigata Hlst. A figure of one of the "Types" of this species was given in the B. & McD. "Contributions" Vol. I, Pt. IV, Pl. XIV, fig. 15, and some years ago I also made a genitalic slide of the female Holotype in the Hulst Collection at New Brunswick, N. J. After further study in this confusing group I now believe that *spaldingi* Tayl., a name based on the male sex, will be better placed as a synonym of *multistrigata* than of *perfusca* Hlst. as I placed it in one of my earlier papers (1929, Can. Ent., LXI, 67). *Perfusca* Hlst., as far as can be told without a study of the type, which seems to be lost, is, as suggested in this same paper, a greyish race of *innotata*. The genitalia of *multistrigata* and *perfusca* are extremely close, but I believe I have found slight, constant differences in the female bursae; among other things the shoulder on the left side at the point where the bursa expands from the chitinized neck seems less prominent in *multistrigata* than in *innotata* forms. In view of the more clear-cut maculation of *multistrigata* as compared with our North American *innotata* races, I am treating it as a distinct species.

Eupithecia cretaceata Pack. Judging by the male and female genitalia this species is misplaced in its present association in the Check List and should be transferred to precede *zygadaeniata* Pack.; there is considerable genitalic similarity between these two species.

Our North American *cretaceata* appears to be the same species as the European *fenestrata* Mill. and, as far as I have been able to ascertain, Packard's name has priority, although Staudinger's catalogue lists it as a synonym. Packard's description appeared in a paper entitled "New North American Phalaenidae" published in the 6th Rep. Peab. Acad. Sci. for 1873 (1874) but a figure of the species was given in a slightly prior paper published in Proc. Bost. Soc. Nat. Hist., XVI, Pl. I, fig. 3 entitled "Catalogue of the Phalaenidae of California, Part II". The portion of the Proceedings containing this article is dated "Nov. 1873" but I have no means of determining whether this was the actual date of publication; however in the March number of the *Canadian Entomologist* for 1874 under "Book Notices" the receipt of Packard's paper is mentioned, so that at the latest the name *cretaceata* was validated in March, 1874. Milliere's paper, which included the description of *fenestrata*, appeared in Part 7 (July) of the Rev. et Mag. Zool. for 1874 so that Packard's name has clearly several months priority.

Eupithecia purpurissata Grossb. Although *valariata* Pears. was placed in the Check List as a direct synonym of *purpurissata*, I had suggested at one

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time (1936, Can. Ent., LXVIII, 259) that both names might be retained for racial forms. After a study of a paratype of *purpurissata* (*ex* U. S. Nat. Mus.) and further San Diego material, including a paratype of *muriflua* Dyar, kindly sent for study by Mr. H. W. Capps, I believe this suggestion should be adhered to. *Purpurissata*, described from Monterey Co., Calif., is larger and with distinctly darker hindwings than is found in Southern Californian (San Diego) specimens, where the basal half of hindwings is pale grayish; the name should be used, therefore, *in sens. strict.* for the race of Middle and Northern California; a male from Mt. Tamalpais, Marin Co. and a female from Klamath, Calif. in the Canadian National Collection agree with Grossbeck's paratype, above mentioned. *Valariata* Pears. with *muriflua* Dyar as a direct synonym (both names based on SanDiego material) can be used for the southern race and the synonymy will stand

purpurissata *Grossb.*	Middle and Northern California
a valariata *Pears.*	Southern California
muriflua Dyar.	

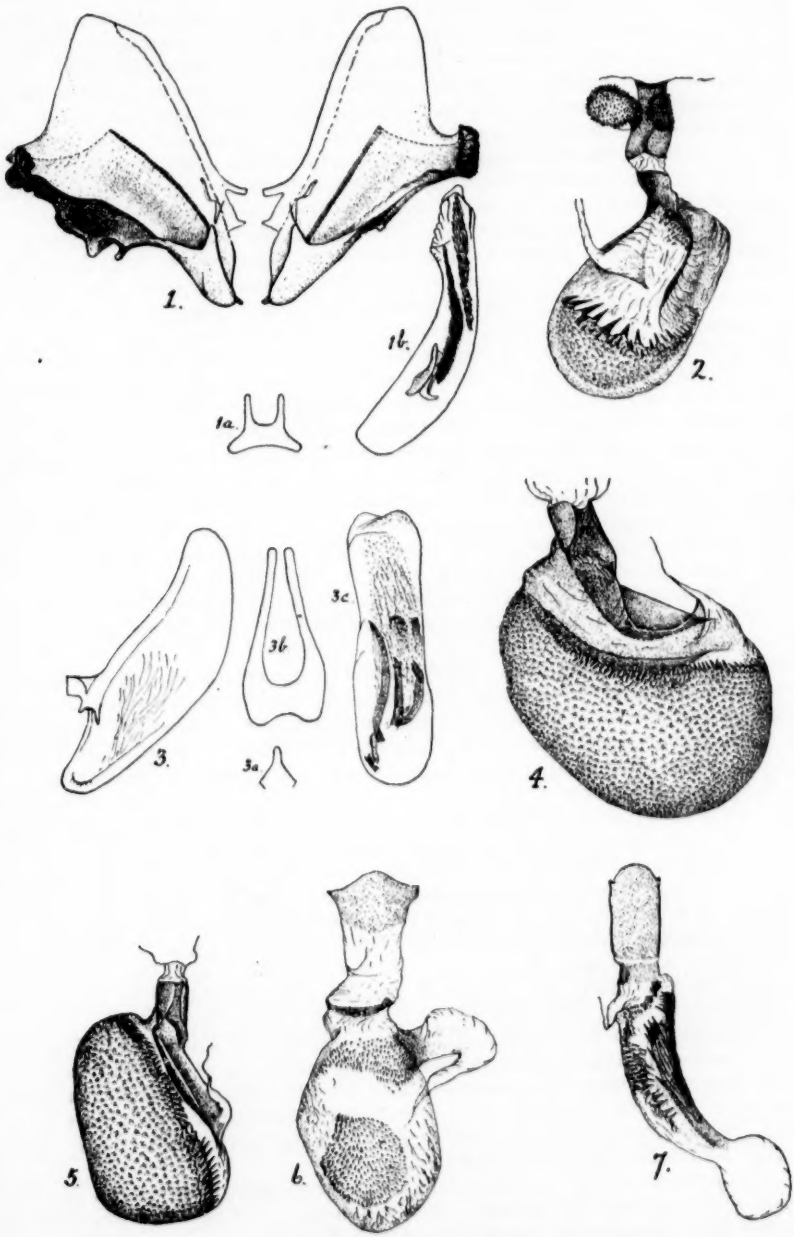
There are no perceivable differences in the genitalia of the type material of all three names; it should be noted, however, that the types of *muriflua* are not two females as stated by Dyar, but a male and a female; in view of Dyar's statement the female should be considered the holotype and Mr. Capps, who has made a slide of the genitalia, informs me that these agree with those of other San Diego females specimens (fig. 5) in their series, one of which was sent me for examination.

Cassino's work on the Geometridae has long been a source of annoyance to other students due to its carelessness and inaccuracy; his specimens are frequently in extremely poor condition and his slides of genitalia are more often than not so crushed and flattened as to be almost unrecognizable. In one of his late articles entitled "On Some *Eupithecia* with Asymmetrical Genitalia" (1925, Lepid. IV, 47) he has committed some particularly flagrant errors, one of which, relating to *E. pinata* Cass., I have already (1940, Can. Ent., LXXII, 39) had occasion to rectify. Further errors in connection with the other species described in this paper have since then come to light; it is now certain that in Cassino's type series sexes have been misidentified, as many as three and four species have been included under the one name in the Paratype series, and in one instance (*gilata*) the association of the sexes appears to have been erroneous. Thanks to the cooperation of Dr. Banks of the Cambridge Museum of Comparative Zoology and of Mr. H. W. Capps of the United States National Museum and to a study of considerable material in our own collection, I believe that the muddle has been more or less satisfactorily straightened out. I offer the following notes in this connection.

Eupithecia miamata Cass. A male Paratype, labelled as a female, is deposited in the Canadian National Collection. The genitalia agree with the figure given by Cassino (*op. cit.* p. 49); I have also seen a similar genitalic slide from a Paratype in the U. S. National Museum. According to Mr. Capps the Paratype series in the U. S. National Museum includes specimens of both *gilata* and *mystiata*. The species is evidently closely allied to *scabrogata* Pears. and should be placed next it in the list.

Eupithecia gilata Cass. I have examined the slide, made from a male Paratype, from which Cassino made his drawing (*op. cit.* p. 51) and a similar one of his slides, together with the very worn male specimen, is now in our collection. Cassino's figure is recognizable, although crude, and has been drawn from the dorsal view, rather than from the more usual ventral one; no slide has been made of the male holotype and I must for the present presuppose that

PLATE XIII.



SPECIES OF *EUPITHECIA*

it and the paratypes agree. Another male Paratype sent me proved to belong to *mystiata* Cass. and I have examined the slide of a further male Paratype in the U. S. National Museum which appears to be *alpinata* Cass. Female Paratypes, distributed both to the U. S. National Museum and to myself, did not seem, on careful examination, to be correctly associated with the males; the palpi were distinctly longer and the color of the primaries, as far as could be recognized, much grayer. A small series of specimens in excellent condition from Sonoma, Marin and Napa Cos., Calif. proved most helpful in solving the puzzle. The genitalia of male specimens agreed exactly with Cassino's slides but the females, without doubt correctly associated, showed an entirely different type of genitalia to those of the so-called Paratype females, which, in consequence, must be considered as representing some other species. Whether Cassino's Allotype and other Paratype Females of *gilata* are similar can only be determined by examination; figures of the genitalia of both sexes (fig. 1, 2) of what I am calling *gilata* are given to avoid any misunderstanding. These wrongly placed females may very possibly belong to *vitreotata* Cass.; the bursa (fig. 7) is a curious leg-like affair very similar to that of *zelmira* Cass. which, in its turn, has a type of male genitalia practically similar to the figure given by Cassino (1927, Lepid., IV, 84) under *vitreotata*. I have, however, no males which I can match with the females, nor have I had opportunity of examining the unique male type of *vitreotata* from "Colorado", so the matter must rest in abeyance, awaiting receipt of further material. *Gilata*, as I determine it, has rather unicolorous deep smoky brown primaries with little definite maculation except a small discal dot and a minute, white, tornal spot; the secondaries are faintly smoky with deeper suffusion around outer and inner margins. The front is rather flat, the palpi quite short and bushy, the male antennae finely ciliate. The abdomen shows a black band across the second segment and there is considerable dorsal brown shading on the segments, this color extending over almost the entire dorsal portion of the rear segments in a quite characteristic manner. The wing expanse is from 19-22 mm.

Eupithecia pinata Cass. All the Paratype specimens of this species which I have examined show the species to be a distinctly smaller one than *gilata*, although the reverse should be the case according to the original descriptions. In many ways the description of *gilata* on page 50 would apply better to the present species than does that on page 52 which I assigned to *pinata* in a previous article; the descriptions are, however, so muddled as to be practically useless and one is forced to rely solely on the genitalic figures in establishing identity. I have a male before me, the genitalia of which agree with the figure on page 53, captioned as *gilata*, but corrected on page 72 to *pinata;* a female paratype labelled as "male" is also in our collection and I figure these genitalia; (fig. 6) a further female is before me from the Baboquivari Mts., Ariz., Apr. 27, 1938 (G. and J. Sperry) and I have seen other slides of both sexes which agree, sent from the U. S. National Museum by Mr. Capps. According to information supplied by Dr. Banks the Holotype and most of the Paratypes are labelled Pinal Co., Ariz., Apr. 1-15, 1925.

Pinata, as so determined, has a wing expanse of 15-18 mm. The front is more rounded than in *gilata*, without being bulging, and the palpi are much longer than those of *gilata*, projecting well beyond the front. The maculation appears to be fairly well-defined but our specimens are too poor to give any details; the general color is deep smoky gray. On genitalic characters the species is evidently closely allied to *bonita* C. & S.

Eupithecia sierrae v. *joymakeata* Cass. According to Dr. Banks the labels on the type series are very variable. The Holotype, Allotype and three Paratypes are labelled *"Eupithecia joymakeata,* Pinal Mts., Pinal Co. Ariz., Apr. 1-15, 1925"; one of these Paratypes, a female, is in our collection. Other Paratypes

bear simply the name without locality data; one such male is before me. There is no Holotype of *"sierrae* race *joymakeata"* but a single Paratype from "near Miami, Ariz., Mch., 1925" is so labelled and another from same locality simply reads "race *joymakeata"* with the *"sierrae."* From comparison of some of the above specimens with Colorado (topotypical) material I should be inclined to place *joymakeata* Cass. as a direct synonym of *sierrae* Hlst.; I can see no very essential differences other than the usual individual ones. The amount of brownish or ruddy suffusion on the primaries is variable but the species is easily determined in the males by the long antennal ciliae, the short chunky palpi and the broad ventral plate with two curved arms. The dark patch on costa of primaries before apex is also a useful character in both sexes.

Eupithecia mystiata Cass. Why this species was included in a paper dealing supposedly with Eupithecias with asymmetrical genitalia is a puzzle; the male claspers are perfectly symmetrical and normal; the uncus is simple, rather flat and broad and shows similarity in this respect to that of *purpurissata* Grossb. with which the species should be associated, the female bursae of the two species being also obviously allied. Cassino's type series shows the usual sex-misdetermination, in fact a goodly proportion of specimens marked as "males" are in reality females and it was only with difficulty that I finally secured a male Paratype; however, I now have one of Cassino's genitalic slides, with specimen, before me, as well as two female Paratypes and have seen other slides which agree from the U. S. National Museum. One Paratype sent me proved to be a worn male of *bolteri* Hlst.

A small series of specimens in excellent condition from Sonoma and Napa Cos., Calif., sent me recently, show that the species can be very readily confused with *scabrogata* Pears.; there is a distinct tendency for the primaries to show an oblique brown shade between the cell and apex of wing, which at times, as in the form *gilvipennata* C. & S., may broaden out to a prominent band of color. The presence of a well-defined discal spot on primaries in *mystiata* and the deeper color of the hindwings with more definite, broad, marginal, dark band are superficial characters useful in separating the two; the genitalia are totally distinct. The front is distinctly, flatly bulging, being well raised above the level of the eyes and the palpi are quite short and do not exceed the frontal margin; the male antennae are very feebly ciliate.*

EXPLANATION OF PLATE XIII.

1. Male Claspers of *Eupithecia gilata* Cass.; la, Anal plate; 1b. Aedeagus.
2. Female Bursa of *E. gilata* Cass. (dorsal).
3. Male Clasper of *E. mystiata* Cass.; la. Uncus; lb. Anal plate; lc. Aedeagus.
4. Female Bursa of *E. mystiata* Cass. (ventral).
5. Female Bursa of *E. purpurissata* var. *valariata* Pears. (ventral).
6. Female Bursa of *E. pinata* Cass. (Ventral).
7. Female Bursa of so called *E. gilata* according to Cassino's Paratypes (misassociation) (dorsal).

*Since the above notes were written, Mr. J. Sperry has visited the Cambridge Museum and at my request has examined the types of the above Cassino species. He writes me that the *gilata* Holotype is a ♀ marked ♂ and the Allotype a ♂ marked ♀, and that the Holotype does not seem to be conspecific with the rest of the series. Further, that the Holotypes of both *pinata* and *mystiata* do not fit well with the rest of the series and, in fact, that the latter looks like "a rather well-marked *gilata* male." A slide had been made of the genitalia but was misplaced and could not be examined. Under such circumstances, until a very careful study of the types can be made, I propose to leave the identification of the species standing as in my notes.

NOTES

THE GRASSHOPPER SEED GRAIN MORTGAGES OF 1876 IN MANITOBA

The administrative circumstances surrounding the grasshopper outbreak of 1874-75 were brought to the attention of the Division of Entomology by K. R. Daly, Senior Solicitor of the Department of Mines and Resources. Consulting the records concerning the matter proved it to be of such interest in connection with the history of grasshopper outbreaks in general that it seemed worth while recording in literature. Thus, with the assistance of J. C. Cowan of the Lands, Parks and Forests Branch of the Department of Mines and Resources, and of G. A. Traill of the Records Office of the Department of Agriculture, the following brief note in regard to the matter was prepared.

During the years 1874 and 1875, Manitoba suffered severe grasshopper damage. In the winter of 1875-6, on representation made by the then Minister of Agriculture for Canada, the Hon. L. Letellier, a vote was passed to afford relief, by advances, to inhabitants of Manitoba and the Northwest in consequence of the grasshopper devastations which had occurred. The vote was administered by a committee at Winnipeg, of which Archbishop Tache was chairman. This committee was appointed by the Dominion Government to which it was responsible. The total amount spent by the committee was $85,354.09, of which $64,949.05 was paid for supplies purchased.

The advances to the settlers took the form of foodstuffs and seed grain, which were purchased in the neighbouring states of the United States. The chief foodstuffs purchased, as far as can be learned, were flour and salt pork in barrels. To the actual cost of these materials supplied to the settlers was added 18¾ per cent to cover the expense of administration, in which was included collection and transportation. In all, some 3,835 settlers received this relief in varying amounts. Short mortgages were taken wherever possible with the homesteads as security. These mortgages, bearing simple interest at 6 per cent, from January 1, 1876, were taken to a total amount of $74,296.00. On July 7, 1900, the rate of interest was changed to 5 per cent simple interest.

Under the Seed Grain Mortgages Act of 1876, with a view of facilitating the registration of these mortgages and to relieve the debtors from the cost of registration fees, it was provided that the charges against title to the lands were to be registered at the Dominion Lands Office, Winnipeg, and that the books were to be open to the public during office hours without fee. In order to assist the Registrar of Land Titles at Winnipeg, a list was furnished to him, and his staff made notations against the titles charged. Although an Act passed in 1913 permitted the registration of other Dominion liens by list, the Dominion Lands Office remained the place of record for the 1876 mortgages.

Collections were in the hands of agents of the Dominion Department of Agriculture. The collections were very slow and payments in many cases were made only when it was necessary to secure clear title in case of sale. The total amount collected was $33,673.59. In 1889, collections were placed in the hands of the Commissioner of Dominion Lands at Winnipeg, and in the next six years there was collected, through the agency, $17,129.11.

In 1895, under Order in Council P. C. No. 3822, the entire administration of these mortgages was turned over to the Department of the Interior by the Department of Agriculure. On November 22, 1927, on the creation of the Seed Grain Adjustment Board (Order in Council P. C. 2200), these mortgages were again brought under consideration and $21,580.48 of the principal, and interest to the amount of $64,724.34 were written off. At the present time, March 31, 1941, there is still outstanding $635.41 principal and $1,945.31 interest, and of the principal sum located there has been paid back $42,733.16.

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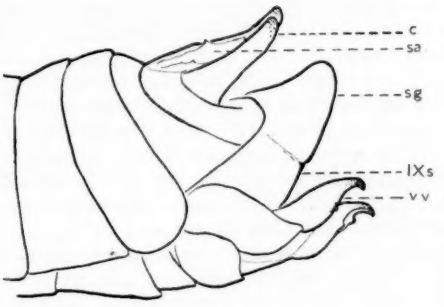
INTERSEXUALITY IN *CAMNULA PELLUCIDA* SCUDDER (ORTHOPTERA)

Although gynandromorphic characteristics have been noted in individuals of a number of insect groups, this condition in grasshoppers is either extremely rare or has received little, if any, attention. Among Orthoptera no reference to the presence of both male and female sexual structures in a single specimen has come to the writer's attention.

The specimen of *Camnula pellucida* in hand was collected by the writer at Riverhurst, Sask., on August 21, 1935. It is a typical male in size and colour; the external genitalia are also normal except that the genital plate is divided



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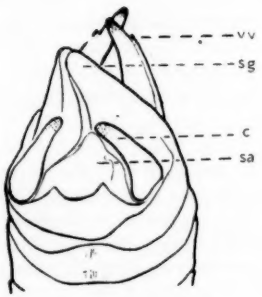

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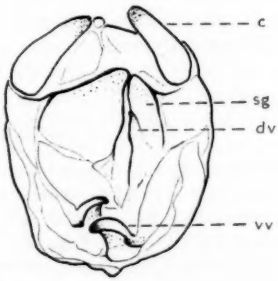

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Intersexuality in *Camnula pellucida* Scudder. Fig. 1, left lateral aspect of posterior portion of abdomen. Fig. 2, dorsal aspect, showing divided subgenital plate. Fig. 3, caudal aspect. *c*, cerci; *dv*, rudiment of dorsal valve of ovipositor; *sa*, supra-anal plate; *sg*, subgenital plate or genital lobe; *vv*, ventral valves of ovipositor; *IXs*, ninth abdominal sternum.

and a pair of normally developed ventral ovipositor valves emerge in the normal female position posterior to the eighth abdominal sternum, while a rudimentary dorsal valve is also present. On the left lateral aspect (fig. 1), the external male genitalia appear to be normal in every respect except for the presence of the valves of the ovipositor. The supra-anal plate and the cerci are typically male, but in the dorsal aspect (fig. 2) it is seen that the entire genital plate, the sternum of the ninth abdominal segment (*IXs*) together with its genital lobe (*sg*), is distinctly divided into two subequal parts. This division is more clearly seen in the posterior aspect (fig. 3), which shows that the right half of the sternum of the ninth abdominal segment and its genital lobe are fused and

have what appears to be a distinct rudimentary dorsal valve of an ovipositor.

No study of the internal sexual structures has been made, because dissections of other dried grasshoppers, collected at the same time and recently soaked and boiled, revealed that it is difficult to dissect such a specimen.

L. C. Paul, Saskatoon, Sask.

NEW HOST RECORDS FOR THE SUGAR BEET NEMATODE, *HETERODERA SCHACHTII* SCHMIDT, IN CANADA

While both the sugar beet strain and the cereal or oat strain of *Heterodera schachtii* Schmidt are to be found in Southern Ontario, the two strains appear to occur in rather widely separated regions and no cases of overlapping of the populations have been observed. During the course of studies of these nematodes, some new Canadian host records were obtained. Four of these records were for the sugar beet strain and one for the oat strain.

The sugar beet strain of *H. schachtii* Schmidt was found in the following wild host plants in the Blackwell district, near Sarnia, Ontario: (1) Common wild mustard, *Brassica arvensis* (L.) Ktze., was found to be frequently and heavily infested. (2) Wormseed mustard, *Erysimum cheiranthoides* L., was found heavily infested quite frequently. (3) Pennycress, or stinkweed, *Thlaspi arvense* L., was frequently infested. (4) Lamb's quarters, *Chenopodium album* L., was found to be occasionally infested.

The cereal or oat strain of *H. schachtii* Schmidt was found infesting Lamb's quarters, *Chenopodium album* L., in an infested oat field near Uxbridge, Ontario. The initial find was made by Mr. W. A. Fowler, Plant Inspection Service, Toronto.

In all the above cases these nematodes had successfully developed to the stage where enlarged white females ("white cysts") were evident on the roots of the host plants. Plant specimens were identified by Mr. E. W. Hart of the Division of Botany, Ottawa.

A. D. Baker,
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BIRDS AS ENEMIES OF POLISTES WASPS.

Some years ago I recorded that birds sometimes pierce the paper nests of *Polistes pallipes* and feed on the larvae; on one particular occasion fifty per cent of the small newly-founded nests of this species were destroyed by an unknown species of bird (Can. Ent. 62:144, 1930). More direct evidence, however, was obtained by Dr. E. S. Anderson who informed me that for two weeks during 1939, he observed a male Summer Tanager (*Piranga rubra rubra*) remove the larvae of *Polistes pallipes* and *P. variatus* from time to time from nests under the eaves of his barn at Gray's Summit, Missouri. These the bird carried to its young in a nest in a nearby tree.

One sometimes finds Polistes' nests with whole series of cells destroyed, and it was at first thought that this was done by the wasps themselves, who removed the cells to obtain building material for new nests, or, if it was a "live" nest, for cells on other parts of the same nest. In this I find I was mistaken; the damaged condition, when it appears, is quite certainly done by birds when removing the larvae from the nests. Of the twelve species of Polistes wasps studied by me in Missouri, Panama, and Mexico, I have never found any evidence of wasps obtaining building material from old nests, or from portions of "live" nests, nor have I ever found any of them using a nest for a second season.

Phil Rau, Kirkwood, Missouri

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